REMARKS

This Amendment is being filed responsive to the June 9, 2005 final Office action that was issued in connection with the above-identified patent application. Prior to the entry of the above amendments, claims 1-3, 6-10, 13, 16, 19-20, 27-29, 31, 33-36 and 44-68 were pending and stand rejected. By the above amendments claim 61 is amended.

As an initial matter, and before turning to the rejections under 35 U.S.C. § 103, Applicants want to address the provisional obviousness-type double patenting rejection set forth in the Office action. Specifically, claims 45-46, 48-49 and 61-65 were provisionally rejected under the judicially-created doctrine of obviousness-type double patenting as being unpatentable over claims 1-2, 4, 6-9, 11, 41 and 46 of co-pending U.S. Patent Application Serial No. 10/379,496. Applicants respectfully request that these provisional rejections be held in abeyance at least through reconsideration of the rejections under 35 U.S.C. § 103. Applicants submit that the provisional rejections of at least claims 45-46 and 48-49 should be withdrawn upon withdrawal of the below-discussed art-based rejections of the claims from which they depend.

Furthermore, Applicants understand that these provisional rejections should be withdrawn when they are the only rejections remaining in this application in order to allow the application to proceed to issuance. (See MPEP § 804.) Therefore, should the Section 103 rejections be withdrawn, Applicants submit that all of the provisional rejections should also be withdrawn so that the application may proceed to allowance and eventual issuance. Should the Examiner, upon reconsideration of the rejections based on cited prior art references, allow some claims that are subject to an

obviousness-type double patenting rejection and some claims that are not subject to such a rejection, Applicants request a telephone interview with the Examiner to discuss the allowed claims, including a potential decision to pursue one set of these claims in a related application.

Turning now to the Section 103 rejections, claims 1, 2, 7-10, 20, 27-29, 31, 33-35, 44 and 47 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,045,933 to Okamoto ("Okamoto") in view of U.S. Patent No. 6,627,338 to St.-Pierre et al. ("St.-Pierre"). Claims 3 and 6 were rejected under 35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre. Claims 13 and 16 were rejected under 35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre and further in view of the *Fuel Cell Systems* publication. Claim 19 was rejected under 35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre and further in view of U.S. Patent Application Publication No. 2001/0026884 to Appleby et al. ("Appleby"). Claims 45-46 and 48-49 were rejected under 35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre and further in view of U.S. Patent No. 4,509,915 to Ito ("Ito"). Claims 50-57 were rejected under 35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre and further in view of *Fuel Cell Systems*. Claims 58 and 60 were rejected under 35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre and further in view of *Fuel Cell Systems*. Claim 59 was rejected under 35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre and *Fuel Cell Systems* and further in view of Appleby. Claims 61-66 and 68 were rejected under 35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre and further in view of Ito. Claim 67 was rejected under

35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre and Ito and further in view of Appleby.

Applicants have studied the cited references in view of the pending claims and the reasons expressed in the Office action. Applicants respectfully disagree that the subject matter of all the claims is rendered obvious by the cited references, alone or in combination. In the following remarks, the unamended independent claims are discussed to more clearly explain how they recite subject matter that is not obvious over any permissible combination of the cited references. In addition, amended claim 61 is discussed to explain how it recites subject matter that is neither disclosed nor suggested in the cited references, individually or in any permitted combination thereof. Applicants request reconsideration of the rejections for at least the reasons discussed below.

Amongst other subject matter, claims 1 and 27 both recite an air delivery system that includes an oxygen-enrichment assembly, including at least one oxygen-selective membrane, to produce an oxygen-enriched air stream for supply to the cathode region of a fuel cell stack. Perhaps more specifically, and amongst other subject matter, claim 1 recites:

> [A]n air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream, wherein the air delivery system includes at least one oxygen-enrichment assembly adapted to produce the oxygen-enriched stream from the air stream, and further wherein the oxygen-enrichment assembly includes at least one oxygen-selective membrane[.]

Amongst other subject matter, claim 27 recites:

> [P]roducing from the air stream an oxygen-enriched stream containing a higher concentration of oxygen gas than the concentration of oxygen gas in the air stream, wherein the producing step occurs in at least one oxygen-selective membrane assembly adapted to receive the air

stream and to produce therefrom the oxygen-enriched stream and a byproduct stream having a lower concentration of oxygen gas than the concentration of oxygen gas in the air stream[.]

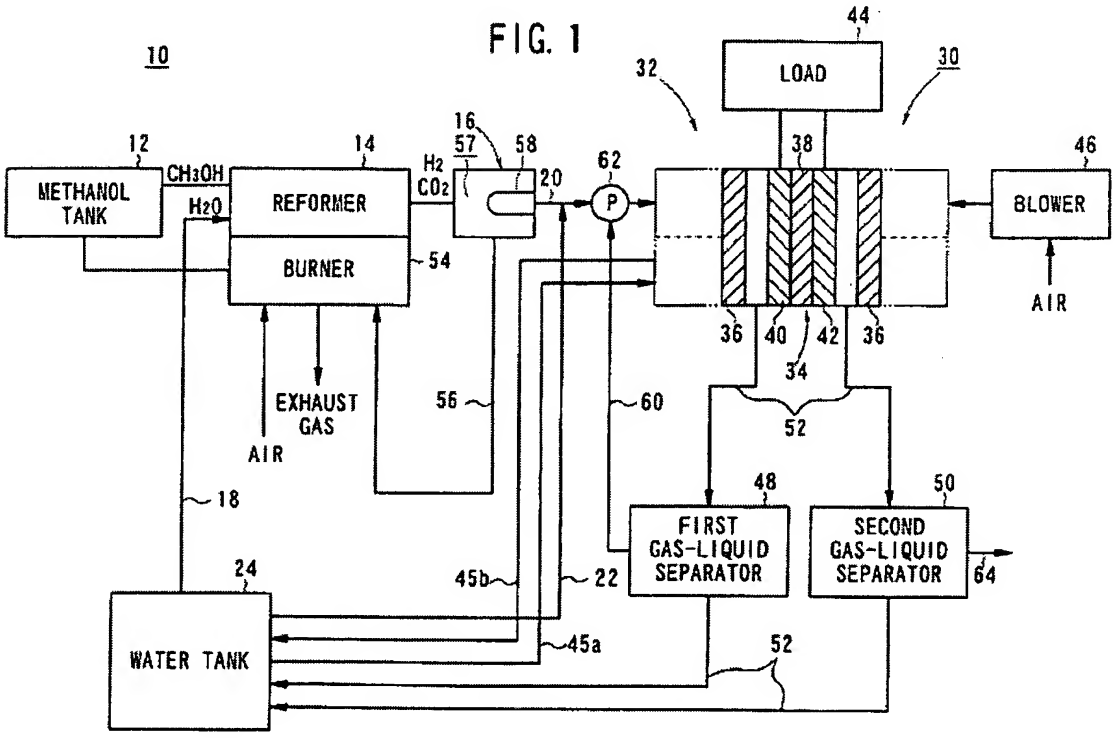
Independent claims 1 and 27 stand rejected as being obvious over Okamoto in view of St.-Pierre. As set forth in the Office action, Okamoto is cited for providing a fuel cell system that discloses all of the subject matter recited in each of these independent claims except for an air delivery system that is configured to produce an oxygen-enriched air stream for use by a fuel cell system. However, the Examiner's position is that St. Pierre discloses the use of an oxygen-enrichment assembly to produce an oxygen-enriched air stream, such as an oxygen-enriched air stream that utilizes at least one oxygen-selective membrane, for use with a fuel cell system. Therefore, the Examiner concludes that it would have been obvious to include such an oxygen-enrichment assembly in the system of Okamoto.

Applicants agree with the Examiner that Okamoto discloses a system that includes a fuel processing assembly that is adapted to produce a product hydrogen stream, an air delivery system that is adapted to produce an air stream, and a fuel cell stack that is adapted to receive the product hydrogen stream and the air stream. Applicants further agree with the Examiner that Okamoto also discloses a water recovery system that is adapted to recover water from the cathode exhaust stream from the fuel cell stack. However, Applicants respectfully disagree with the Examiner that there is sufficient teaching or motivation to replace the blower of Okamoto with the oxygen-enrichment assembly of St.-Pierre. Instead, Applicants submit that the cited references disclose conflicting approaches to providing oxidant to a fuel cell system, and that

introduction of the proposed membrane-based oxygen enrichment assembly of St.-Pierre into the system of Okamoto would render the air delivery system of Okamoto inoperative and unsuitable for its intended purpose.

Okamoto discloses several configurations of fuel cell systems. An exemplary embodiment, shown in Fig. 1 of Okamoto, is reproduced below for the Examiner's convenience.

FIG. 1



With reference to the above figure, the system of Okamoto includes a fuel cell **30** that is supplied with hydrogen gas via a hydrogen gas passage **20** from a fuel processor **14**. A blower **46** provides atmospheric air to the cathode side **42** of the fuel cell. Flowthrough oxidant gas is released via exhaust conduit **52**, travels to second gas-liquid separator **50**, and passes through gas conduit **64** before serving as fuel for a burner

54. Notably, each embodiment disclosed in Okamoto shows that the element corresponding to **46** is described only as a "blower for introducing atmospheric air" (see, for example, Okamoto, col. 3, line 9). This construction is an energy-efficient design in which the fuel cell is supplied with atmospheric air obtained from proximate the fuel cell system.

The Section 103 rejection set forth in the Office action requires the modification of the blower-based air delivery system of Okamoto to include at least one oxygen-selective membrane and to be configured to produce via this at least one membrane an oxygen-enriched air stream for delivery to the cathode region of the fuel cell stack. For at least the reasons discussed below, Applicants submit that this combination is not properly supported by the cited references, and would also render the system of Okamoto inoperative.

First, the oxygen-enrichment assembly of St.-Pierre, including at least one oxygen-selective membrane, would not function properly if included in the system of Okamoto. As noted in Applicants' specification, the utilization of an oxygen-selective membrane to increase the oxygen content of oxidant air is a "pressure-driven separation process" (p. 13, line 22 – p. 14, line 1) that occurs "at a pressure greater than atmospheric pressure, such as a pressure of at least 2 bara ..." (p. 14, lines 8-9). As the air supply mechanism of Okamoto is limited to being a "blower," rather than a compressor or other device designed to provide a pressurized air stream, it would be clear to one of skill in the art that the disclosed "blower" would not provide air under satisfactory conditions for oxygen-selective membrane enrichment. In other words, for an oxygen enrichment mechanism that relies upon at least one oxygen-selective membrane to separate an air

stream into a satisfactory oxygen-enriched air stream for a fuel cell stack, the air stream must be supplied to the oxygen-enrichment assembly at an elevated pressure. However, Okamoto is specifically directed to low-pressure, low complexity air delivery systems that merely require a blower to transport air from proximate the fuel cell stack to the cathode region of the fuel cell stack. Accordingly, Applicants submit that the proposed inclusion of a membrane-based oxygen-enrichment assembly to the system of Okamoto would render the system inoperative because the system would not produce the desired oxygen-enriched air stream.

Second, Okamoto teaches away from using an oxygen-selective membrane to form an enriched-oxygen stream because Okamoto provides only for a relatively low-complexity fuel cell system that appears to avoid many of the equipment cost and energy efficiency issues that more complex fuel cell systems encounter. Adding an oxygen-enrichment assembly, including at least one oxygen-selective membrane, to the system of Okamoto would substantially decrease the energy efficiency of the system and would increase its complexity. For example, adding an oxygen-selective membrane assembly to the system of Okamoto would require at least the addition of a compressor to provide air at the pressure needed to drive the oxygen-enrichment assembly, as well as other attendant structures that draw power and increase complexity. Compressors are known to be much more expensive, require substantial power to operate, and require more maintenance than blowers. As noted in *Fuel Cell Systems*, "[t]he major disadvantage of oxygen enrichment is that the additional power demand to effect the separation of oxygen from air more than offsets the reduction in plant air compression requirements ... enrichment is economically unattractive for stand-alone PAFC systems"

(p. 232). The system of Okamoto may be configured to include a phosphoric acid fuel cell (PAFC) (col. 5, lines 26-32). Accordingly, Applicants submit that including in the system of Okamoto an oxygen-selective membrane oxygen-enrichment assembly as taught by St.-Pierre contradicts the teaching of the efficient, low-complexity fuel cell system of Okamoto. Therefore, Applicants assert that it would not have been obvious to include the oxygen-enrichment assembly of St.-Pierre in the fuel cell system of Okamoto.

For at least the above reasons, Applicants submit that claims 1 and 27 recite subject matter that is not rendered obvious by any proper combination of Okamoto and St.-Pierre. As such, and upon reconsideration of claims 1 and 27, Applicants request that the rejections of claims 1 and 27 be withdrawn and that claims 1 and 27 be allowed.

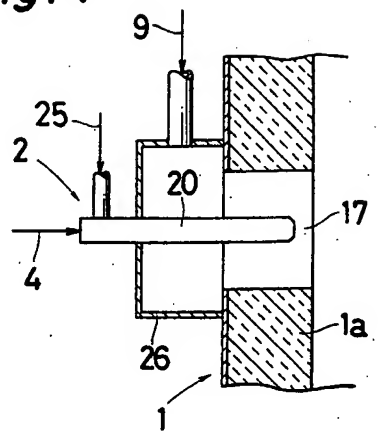
Claims 2-3, 6-10, 13, 16, 19-20, and 44-46 depend from claim 1. Claims 28-29, 31, 33-36, and 47-49 depend from claim 27. Accordingly, these dependent claims should be allowed when independent claims 1 and 27 are allowed. In the interest of brevity, each of these dependent claims is not discussed in detail and each additional reason why these claims are believed to patentably distinguish the cited references is not presented. However, Applicants want to briefly discuss claims 45-46 and 48-49, which depend indirectly from claims 1 and 27, respectively.

Claims 45 and 48 recite that the fuel cell system, which includes an air delivery system that is adapted to produce an oxygen-enriched air stream through the use of at least one oxygen-selective membrane, also is adapted to utilize the byproduct, or reduced-oxygen stream produced when the oxygen-enriched air stream is produced to pressurize a supply of liquid fuel. Claims 46 and 49 respectively depend from claims 45 and 48 and recite that the supply of liquid fuel pressurized by the reduced-oxygen stream

is a supply of liquid fuel from which a feed stream is drawn for the hydrogen-producing fuel processor of the system. Claims 45-46 and 48-49 stand rejected as being obvious over the previously discussed proposed modification of Okamoto in view of St.-Pierre, in further view of Ito.

As to the propriety of the combination of Okamoto and St.-Pierre, Applicants believe the preceding discussion demonstrates that the proposed modification of Okamoto's air delivery system to require a membrane-based oxygen enrichment assembly is contrary to the teachings and desired operation of the Okamoto system. Applicants similarly submit that the further modification of Okamoto to utilize a reduced-oxygen stream is not supported by the cited references. As an initial reason, Applicants respectfully disagree with the Examiner that Ito teaches pressurizing a liquid fuel with a byproduct stream from an oxygen-enrichment assembly. Applicants agree that Ito discloses that oxygen-enriched air and a nitrogen-enriched byproduct air stream may be recovered from an oxygen-enrichment assembly and that this oxygen-enrichment assembly may include at least one oxygen-selective membrane (Ito, col. 1, lines 20-43). However, Ito discloses only that the nitrogen-enriched air supplied from the oxygen-enrichment assembly may be delivered to a burner and used to atomize a stream of liquid fuel (such as heavy oil) that is separately delivered to the burner, with the atomized fuel stream combusted in the burner. For the Examiner's convenience, Fig. 4 of Ito is reproduced below and shows the reduced-oxygen (or nitrogen-enriched) stream 25 being delivered to a burner 2, where it atomizes a fuel stream 4 in spraying cylinder 20.

Fig. 4



Applicants submit that Ito fails to disclose or suggest pressurizing a supply of liquid fuel with a nitrogen-enriched air stream, much less pressurizing a supply of liquid fuel from which a feed stream for a hydrogen-producing fuel processor is drawn. Instead, Ito merely atomizes a separately delivered fuel stream that has already been drawn from a supply, with this atomized stream thereafter being combusted to produce heat. In contrast, claims 45 and 48 recite that the reduced-oxygen stream is used to pressurize a supply of liquid fuel, with claims 46 and 49 reciting that this liquid fuel is a reactant from which hydrogen gas is produced. Accordingly, Applicants submit that even if the proposed combination of Okamoto, St.-Pierre and Ito is made, the reconstructed system still fails to disclose or suggest the subject matter recited in claims 45-46 and 48-49.

Applicants further submit that the cited references fail to provide any teaching or motivation for the proposed further modification of the system of Okamoto. As discussed, Okamoto is designed to utilize an air delivery system that is incompatible with the proposed oxygen-enrichment assembly. Accordingly, it follows that the system

of Okamoto is similarly not configured to produce a nitrogen-enriched air stream, much less to utilize this stream to pressurize the methanol from which Okamoto produces hydrogen gas. St.-Pierre similarly fails to disclose or suggest utilization of the nitrogen-enriched air stream, and Ito discloses only the use of this stream in a burner to atomize a liquid fuel stream that is separately delivered to the burner. Therefore, the references, even if their disclosures are all combined, still fail to disclose or suggest the subject matter recited in claims 45-46 and 48-49. Accordingly, Applicants request reconsideration and withdrawal of the rejections of claims 45-46 and 48-49.

Claim 50 stands rejected as being obvious over the combination of Okamoto with St.-Pierre, as discussed above, as further modified by the disclosure of *Fuel Cell Systems*. Amongst other subject matter, claim 50 recites a fuel cell system having a hydrogen-producing fuel processing assembly, an air delivery system with an oxygen-enrichment assembly that is adapted to produce an oxygen-enriched air stream, and a fuel cell stack that is adapted to receive hydrogen from the fuel processing assembly, oxygen-enriched air from the oxygen-enrichment assembly, and *a secondary air stream*. Claim 50 is reproduced below for the Examiner's convenience.

> 50. A fuel cell system, comprising:
>
> a fuel processing assembly adapted to produce a product hydrogen stream containing at least substantially pure hydrogen gas from at least one feed stream comprising at least a carbon-containing feedstock;
>
> an air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream, wherein the air delivery system includes at least one oxygen-enrichment assembly adapted to produce the oxygen-enriched stream from the air stream;
>
> a fuel cell stack adapted to receive at least a portion of the product hydrogen stream, the oxygen-enriched stream and a secondary air stream

and to produce an electric current therefrom, wherein the fuel cell stack is adapted to emit a cathode exhaust stream containing water; and

a water-recovery assembly adapted to receive the cathode exhaust stream and to produce a product water stream therefrom.

As expressed in the Office action, the previously discussed combination of Okamoto and St.-Pierre still fails to disclose or suggest the provision of a secondary air stream to the fuel cell stack in addition to the oxygen-enriched air stream, much less to recite whether the air streams are delivered together or as separate streams (as recited in dependent claims 52 and 53). However, *Fuel Cell Systems* discloses that the increased concentration of oxygen gas produced by an oxygen-enrichment assembly may be thereafter reduced by adding air to the oxygen-enriched air stream.

Applicants respectfully request reconsideration of the rejection, as the references fail to provide the required teaching or motivation to support a prima facie obviousness rejection of claim 50. In addition to the previously discussed reasons why the proposed combination of Okamoto with St.-Pierre is not properly supported, the proposed further modification not only requires the simple system of Okamoto to include even more structure (i.e., structure associated with providing a secondary air stream to the fuel cell system in addition to the oxygen-enriched air stream), but also at least partially undoes the primary modification proposed in view of St.-Pierre (i.e., the introduction of an oxygen-enrichment assembly). In other words, Applicants submit that it would not be obvious to modify the fully functional system of Okamoto to include the more complex and expensive and less efficient structures of St.-Pierre, and then to further modify the system to return toward the original result that was present in Okamoto.

For at least these reasons, Applicants submit that claim 50 recites subject matter that is not made obvious by a combination of Okamoto and St.-Pierre, much less the further proposed combination of Okamoto, St.-Pierre and *Fuel Cell Systems*. As such, Applicants request that the rejection of claim 50 be withdrawn and that claim 50 be allowed. Claims 51-60 depend from claim 50 and therefore should be allowed when claim 50 is allowed. In the interest of brevity, each of these dependent claims is not discussed in detail and each additional reason why these claims are believed to patentably distinguish the cited references is not presented.

Claim 61 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Okamoto in view of St.-Pierre and further in view of Ito. As expressed in the Office action, Ito is cited for teaching that the nitrogen-enriched byproduct stream produced by the oxygen-enrichment assembly of St.-Pierre should be used to pressurize the supply of liquid fuel from which the fuel processor of Okamoto produces hydrogen gas. The basis of this rejection and the disclosures of these references has been previously discussed with respect to claims 45-46 and 48-49.

As an initial matter, claim 61 has been amended to clarify that the at least one feed stream from which the fuel processing assembly produces hydrogen gas is drawn as a liquid stream from the supply of liquid fuel that is pressurized by the byproduct stream from the oxygen-enrichment assembly. Amended independent claim 61 is reproduced below for the Examiner's convenience.

> 61. (Currently amended) A fuel cell system, comprising:
> a fuel processing assembly adapted to produce a product hydrogen stream containing at least substantially pure hydrogen gas from at least one feed stream, wherein the at least one feed stream includes a carbon-containing feedstock <u>drawn as a liquid</u> from a supply of liquid fuel;

an air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream and a byproduct stream having a lower concentration of oxygen gas than the air stream, wherein the air delivery system includes at least one oxygen-enrichment assembly adapted to produce the oxygen-enriched stream from the air stream, and further wherein the byproduct stream is used to pressurize the supply of liquid fuel;

a feedstock delivery system adapted to draw the carbon-containing feedstock from the pressurized supply of liquid fuel;

a fuel cell stack adapted to receive at least a portion of the product hydrogen stream and the oxygen-enriched stream and to produce an electric current therefrom; wherein the fuel cell stack is adapted to emit a cathode exhaust stream containing water; and

a water-recovery assembly adapted to receive the cathode exhaust stream and to produce a product water stream therefrom.

Support for the claimed subject matter can be found in Applicants' specification, such as at page 14, lines 16-21. This subject matter has also been previously considered and searched by the Examiner in the context of claims 45-46 and/or claims 48-49. Accordingly, Applicants submit that this above amendment neither adds new matter to the application nor requires an additional search. As such, Applicants request entry and consideration of this amendment despite the final nature of the most recent Office action. Applicants submit that the cited references, even if properly combined, still fail to disclose the subject matter recited in prior or amended claim 61. As discussed above in connection with claims 45-46 and 48-49, Ito fails to disclose pressurizing a supply of liquid fuel, much less a supply from which a reactant stream for a hydrogen-producing fuel processor is drawn. Accordingly, Applicants submit that claim 61 recites subject matter that patentably distinguishes the proposed combination of Okamoto with St.-Pierre and Ito. As such, and upon consideration of amended claim 61,

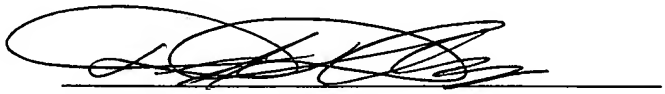
Applicants request that the rejection of claim 61 be withdrawn and that claim 61 be allowed.

Claims 62-68 depend from claim 61 and therefore should be allowed when claim 61 is allowed. For the purpose of brevity, each of these dependent claims is not discussed in detail and each additional reason why these claims are believed to patentably distinguish the cited references is not presented.

With the entry of the above amendment, and for the reasons discussed herein, Applicants submit that all of the issues raised in the final Office action have been addressed and overcome. If there are any remaining issues or if the Examiner has any questions, Applicants' undersigned attorney may be reached at the number listed below. Similarly, if the Examiner believes that a telephone interview may be productive in advancing prosecution of the present application, including addressing any potential remaining issues relating to the provisional obviousness-type double patenting rejection, the Examiner is invited to contact Applicants' undersigned attorney at the number listed below.

Respectfully submitted,

KOLISCH HARTWELL, P.C.



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